

In the Claims:

A complete listing of claims in the instant application is provided below as follows:

1 1. (Currently amended) A method of processing a digital image,
2 comprising the steps of:

3 providing digital data indexed to represent positions of an
4 image having S spectral bands for simultaneous output on a
5 display, said digital data being indicative of an intensity value
6 $I_i(x,y)$ for each position (x,y) in each i-th spectral band;
7 ~~— defining a classification of said image based on evaluating~~
8 features of said image indicative of dynamic range of said image
9 in each of said S spectral bands to thereby identify a class
10 associated with said dynamic range;

11 adjusting said intensity value for said each position in
12 each i-th spectral band to generate an adjusted intensity value
13 for said each position in each i-th spectral band in accordance
14 with

$$\sum_{n=1}^N W_n (\log I_i(x,y) - \log [I_i(x,y) * F_n(x,y)]), i=1, \dots, S$$

15 where S is the number of unique spectral bands included in said
16 digital data and, for each n, W_n is a weighting factor and
17 $F_n(x,y)$ is a unique surround function applied to said each
18 position (x,y) and N is the total number of unique surround
19 functions;

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20 selecting a filter function based on said class, said filter
21 function so-selected being optimized in terms of offset and gain
22 for said dynamic range associated with said class; and

23 filtering said adjusted intensity value for said each
24 position of said image in each of said S spectral bands using a
25 said filter function based on said classification of said image
26 so-selected, wherein a filtered intensity value $R_i(x,y)$ is
27 defined.

1 2. (Original) A method according to claim 1 wherein each said
2 unique surround function is a Gaussian function.

1 3. (Original) A method according to claim 2 wherein said
2 Gaussian function is of the form

$$e^{\frac{-r^2}{c_n^2}}$$

3 satisfying the relationship

$$k_n \iint e^{\frac{-r^2}{c_n^2}} dx dy = 1$$

4 where

$$r = \sqrt{x^2 + y^2}$$

5 and, for each n, k_n is a normalization constant and c_n is a
6 unique constant for each of said N unique surround functions.

1 4. (Original) A method according to claim 1 further comprising
2 the step of multiplying said filtered intensity value $R_i(x,y)$ by

$$\log \left[\frac{B I_i(x,y)}{\sum_{i=1}^S I_i(x,y)} \right]$$

3 to define a color-restored intensity value $R'_i(x,y)$, where B is a
4 constant.

1 5. (Original) A method according to claim 1 wherein said each
2 position (x,y) defines a pixel of said display.

1 6. (Original) A method according to claim 1 wherein, for each n,
2 $W_n=1/N$.

1 7. (Currently amended) A method according to claim 1 wherein
2 ~~said step of defining comprises the step of using features of~~
3 ~~said image comprise~~ image statistics associated with said image
4 in each of said S spectral bands ~~to select said filter function.~~

1 8. (Original) A method according to claim 7 wherein said image
2 statistics include brightness and contrast of said image in each
3 of said S spectral bands.

1 9. (Original) A method according to claim 1 further comprising
2 the steps of:

3 selecting a maximum intensity value $V_i(x,y)$ from the group
4 consisting of said intensity value $I_i(x,y)$ and said filtered
5 intensity value $R_i(x,y)$; and

6 displaying an improved image using said maximum intensity
7 value $V_i(x,y)$.

1 10. (Original) A method according to claim 4 further comprising
2 the steps of:

3 selecting a maximum intensity value $V_i(x,y)$ from the group
4 consisting of said intensity value $I_i(x,y)$ and said color-
5 restored intensity value $R'_i(x,y)$; and

6 displaying an improved image using said maximum intensity
7 value $V_i(x,y)$.

1 11. (Currently amended) A method of processing a digital image,
2 comprising the steps of:

3 providing digital data indexed to represent the positions of
4 a plurality of pixels of a J-row by K-column display, said
5 digital data being indicative of an intensity value $I(x,y)$ for
6 each of said plurality of pixels where x is an index of a
7 position in the J-th row of said display and y is an index of a
8 position in the K-th column of said display wherein a JxK image
9 is defined;

10 evaluating features of said JxK image indicative of dynamic
11 range of said JxK image to thereby identify a class associated
12 with said dynamic range;

13 convolving said digital data associated with each of said
14 plurality of pixels with a function

$$e^{-\frac{r^2}{c^2}}$$

15 to form a discrete convolution value for each of said plurality
16 of pixels, said function satisfying the relationship

$$k \iint e^{-\frac{r^2}{c^2}} dx dy = 1$$

17 where

$$r = \sqrt{x^2 + y^2}$$

18 k is a normalization constant and c is a constant;

19 converting, for each of said plurality of pixels, said

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20 discrete convolution value into the logarithm domain;
21 converting, for each of said plurality of pixels, said
22 intensity value into the logarithm domain;
23 subtracting, for each of said plurality of pixels, said
24 discrete convolution value so-converted into the logarithm domain
25 from said intensity value so-converted into the logarithm domain,
26 wherein an adjusted intensity value is generated for each of said
27 plurality of pixels;
28 selecting a filter function based on said class, said filter
29 function so-selected being optimized in terms of offset and gain
30 for said dynamic range associated with said class; and
31 filtering said adjusted intensity value for each of said
32 plurality of pixels with a said filter function ~~that is based on~~
33 ~~dynamic range of said JxK image~~ so-selected, wherein a filtered
34 intensity value $R(x,y)$ is defined.

1 12. (Original) A method according to claim 11 wherein the value
2 of said constant c is selected to be in the range of
3 approximately 0.01 to approximately 0.5 of the larger of J and K .

1 13. (Original) A method according to claim 11 further comprising
2 the steps of:
3 selecting, for each of said plurality of pixels, a maximum
4 intensity value $V(x,y)$ from the group consisting of said
5 intensity value $I(x,y)$ and said filtered intensity value $R(x,y)$;
6 and
7 displaying an improved image using said maximum intensity
8 value $V(x,y)$.

1 14. (Currently amended) A method of processing a digital image,
2 comprising the steps of:

3 providing digital data indexed to represent the positions of
4 a plurality of pixels of an J-row by K-column display, said
5 digital data being indicative of an intensity value $I_i(x,y)$ for
6 each i-th spectral band of S spectral bands for each of said
7 plurality of pixels where x is an index of a position in the J-th
8 row of said display and y is an index of a position in the K-th
9 column of said display wherein a $(J \times K)_i$ image is defined for each
10 of said S spectral bands and a JxK image is defined across all of
11 said S spectral bands;

12 ~~— defining a classification of said JxK image based on~~
13 evaluating features of each said $(J \times K)_i$ image indicative of
14 dynamic range of each said $(J \times K)_i$ image to thereby identify a
15 class associated with said dynamic range;

16 convolving said digital data associated with each of said
17 plurality of pixels in each i-th spectral band with a function

$$e^{\frac{-r^2}{c_n^2}}$$

18 for n=2 to N to form N convolution values for each of said
19 plurality of pixels in each said i-th spectral band, said
20 function satisfying the relationship

$$k_n \iint e^{\frac{-r^2}{c_n^2}} dx dy = 1$$

21 where

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$$r = \sqrt{x^2 + y^2}$$

and, for each n , k_n is a normalization constant and c_n is a unique constant;

converting, for each of said plurality of pixels in each said i -th spectral band, each of said N convolution values into the logarithm domain;

converting, for each of said plurality of pixels in each said i -th spectral band, said intensity value into the logarithm domain;

subtracting, for each of said plurality of pixels in each said i -th spectral band, each of said N convolution values so-converted into the logarithm domain from said intensity value so-converted into the logarithm domain, wherein an adjusted intensity value is generated for each of said plurality of pixels in each said i -th spectral band based on each of said N convolution values;

forming a weighted sum for each of said plurality of pixels in each said i -th spectral band using said adjusted intensity values;

selecting a filter function based on said class, said filter function so-selected being optimized in terms of offset and gain for said dynamic range associated with said class; and

filtering said weighted sum for each of said plurality of pixels in each said i -th spectral band with a said filter

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45 ~~function that is based on said classification of said JxK image~~
46 so-selected, wherein a filtered intensity value $R_i(x,y)$ is
47 defined.

1 15. (Original) A method according to claim 14 wherein the value
2 for each said unique constant c_n is selected to be in the range
3 of approximately 0.01 to approximately 0.5 of the larger of J and
4 K.

1 16. (Original) A method according to claim 14 further comprising
2 the step of multiplying said filtered intensity value $R_i(x,y)$ by

$$\log \left[\frac{B I_i(x,y)}{\sum_{i=1}^S I_i(x,y)} \right]$$

3 to define a color-restored intensity value $R'_i(x,y)$, where B is a
4 constant and S is a whole number greater than or equal to 2.

1 17. (Currently amended) A method according to claim 14 wherein
2 ~~said step of defining comprises the step of using~~ features of
3 said $(JxK)_i$ image comprise image statistics associated with each
4 ~~said $(JxK)_i$ image to select said filter function.~~

1 18. (Original) A method according to claim 17 wherein said image
2 statistics include brightness and contrast of each said $(JxK)_i$

3 image.

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1 19. (Original) A method according to claim 14 further comprising
2 the steps of:

3 selecting a maximum intensity value $V_i(x,y)$ from the group
4 consisting of said intensity value $I_i(x,y)$ and said filtered
5 intensity value $R_i(x,y)$; and

6 displaying an improved image using said maximum intensity
7 value $V_i(x,y)$.

1 20. (Original) A method according to claim 16 further comprising
2 the steps of:

3 selecting a maximum intensity value $V_i(x,y)$ from the group
4 consisting of said intensity value $I_i(x,y)$ and said color-
5 restored intensity value $R'_i(x,y)$; and

6 displaying an improved image using said maximum intensity
7 value $V_i(x,y)$.

21. (Currently amended) A method of processing a digital image,
comprising the steps of:

providing digital data indexed to represent positions of an
image having S spectral bands for simultaneous output on a
display, said digital data being indicative of an intensity value
 $I_i(x,y)$ for each position (x,y) in each i-th spectral band;

~~—defining a classification of said image based on evaluating~~
features of said image indicative of dynamic range of said image
in each of said S spectral bands to thereby identify a class
associated with said dynamic range;

adjusting said intensity value for said each position in
each i-th spectral band to generate an adjusted intensity value
for said each position in each i-th spectral band in accordance
with

$$\sum_{n=1}^N W_n (\log I_i(x,y) - \log [I_i(x,y) * F_n(x,y)]), i=1, \dots, S$$

where S is a whole number greater than or equal to 2 and defines
the total number of spectral bands included in said digital data
and, for each n, W_n is a weighting factor and $F_n(x,y)$ is a unique
surround function of the form

$$e^{-\frac{r^2}{c_n^2}}$$

satisfying the relationship

$$k_n \iint e^{-\frac{r^2}{c_n^2}} dx dy = 1$$

20 where

$$r = \sqrt{x^2 + y^2}$$

21 and, for each n , k_n is a normalization constant and c_n is a
22 unique constant where N is the total number of unique surround
23 functions;

24 selecting a filter function based on said class, said filter
25 function so-selected being optimized in terms of offset and gain
26 for said dynamic range associated with said class;

27 filtering said adjusted intensity value for said each
28 position in each i -th spectral band with a said function ~~based on~~
29 ~~said classification of said image~~ so-selected wherein a filtered
30 intensity value $R_i(x,y)$ is defined; and

31 multiplying said filtered intensity value $R_i(x,y)$ by

$$\log \left[\frac{B I_i(x,y)}{\sum_{i=1}^s I_i(x,y)} \right]$$

32 to define a color-restored intensity value $R'_i(x,y)$, where B is a
33 constant.

1 22. (Original) A method according to claim 21 wherein, for each
2 n , $W_n = 1/N$.

1 23. (Original) A method according to claim 21 wherein the value
2 for each said unique constant c_n is selected to be in the range
3 of approximately 0.01 to approximately 0.5 of the larger of J and
4 K.

1 24. (Currently amended) A method according to claim 21 wherein
2 ~~said step of defining comprises the step of using~~ features of
3 said image comprise image statistics associated with said image
4 in each of said S spectral bands ~~to select said filter function.~~

1 25. (Original) A method according to claim 24 wherein said image
2 statistics include brightness and contrast of said image in each
3 of said S spectral bands.

1 26. (Original) A method according to claim 21 further comprising
2 the steps of:

3 selecting a maximum intensity value $V_i(x,y)$ from the group
4 consisting of said intensity value $I_i(x,y)$ and said color-
5 restored intensity value $R'_i(x,y)$; and

6 displaying an improved image using said maximum intensity
7 value $V_i(x,y)$.